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The *GPS to Success* Growth Grids: Measurement Properties of a Tool to Promote Intentional Self Regulation in Mentoring Programs[1]

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Abstract

Intentional self-regulatory, or goal-directed skills, are essential during adolescence as youth set and work towards long-term goals within a dynamic context. Youth development programs that incorporate mentoring may provide a key resource for building these skills. In the present study, we provide initial data about the factor structure for a set of measures aimed at assessing youth intentional self-regulation (ISR) within mentoring programs, termed the "GPS growth grids." Using data from 409 mentor and youth dyads from 24 programs around the U.S., we assess whether the underlying factors indexed by the growth grids can be invariantly measured across mentor and mentee raters and three times of measurement. Results indicated that a single-factor structure best fit these data for both older and younger mentee age groups. Older mentee and mentor data displayed measurement invariance across time and rater, while younger mentee and mentor data displayed invariance across time. Results also indicated differences across rater and age group in terms of factor correlations, means, and variances. Overall, these findings support the use of these measures for future longitudinal work that would examine the role of various youth, mentor, and youth-serving program characteristics in promoting the development of youth ISR skills.

Goals give meaning and direction to life, and are linked to subjective well-being and adaptive functioning across the life span (e.g., Freund & Baltes, 1998; Little, 1989). The way individuals actively organize their resources and act to achieve their goals has been termed intentional self-regulation (ISR; e.g., Gestsdóttir & Lerner, 2008; Napolitano, Bowers, Gestsdóttir, & Chase, 2011). In research derived from the 4-H Study of Positive Youth Development (PYD; Lerner, Lerner, von Eye, Bowers, & Lewin-Bizan, 2011), adolescents' ISR has been linked to higher levels of healthy behavior and positive development both concurrently and longitudinally in samples of over 1,000 youth from ten to eighteen years of age (e.g., Bowers, Gestsdóttir et al., 2011a; Zimmerman, Phelps, & Lerner, 2007, 2008). In light of these findings and related research (e.g., Duckworth, Peterson, Matthews, & Kelly, 2007), building ISR skills to promote PYD has become a key concept in the organization and structuring of youth development programs (Balcazar & Keys, 2014). Although an increasing number of youth-serving programs have defined the development of skills like ISR as central to their mission (Duerden, Witt, Fernandez, Bryant, & Theriault, 2012), there are actually few evidence-based measures and curricula available for these programs to implement.

In an attempt to address this need, we designed the *GPS to Success* intervention materials (Bowers et al., 2013; Napolitano, Bowers, Gestsdóttir, & Chase, 2011) to help mentors in youth-serving organizations discuss, assess, and build ISR skills with youth. The purpose of the present study is to examine the factorial structure and longitudinal measurement invariance of the core tools of *GPS to Success* – a set of measures termed "GPS growth grids" that provide a standardized way for youth and mentors to discuss and assess youth GPS skills. An invariant factorial structure is an essential requirement for future latent longitudinal analyses involving the

GPS growth grids. Such future work may expand our understanding of the development of ISR in adolescence and, in turn, the role that mentoring programs may play in that development.

Intentional Self Regulation in Adolescence

Across the life span, individuals are developing within complex and changing physical, social, cultural, and historical contexts. Making sense of and prospering in these contexts requires individuals to make decisions about how to act in order to their meet personal needs in the face of shifting environmental demands and access to resources (Brandtstädter, 1998, 2006). The requirements for such developmental regulations undergo significant developmental change during the second decade of life (Napolitano, Bowers, Gestsdóttir, & Chase, 2011). For adolescents, these dramatic changes occur across all levels of their developmental system – from the cognitive and physiological (e.g., Spear, 2000; Paus, 2009) through social, political, and economic (e.g., Crockett & Silbereisen, 2000) – accentuating the importance of the ability of youth to adaptively develop (Brandtstädter, 2006) and to produce their own development (Gestsdóttir & Lerner, 2008, Lerner, 1982).

Adolescents can guide their development through selecting and working towards their goals using ISR (Lerner, Freund, DeStefanis, & Habermas, 2001). While there are several conceptually overlapping operationalizations of ISR (see Brandtstädter & Lerner, 1999; Lerner et al., 2011), we based *GPS to Success* on a model that has been especially influential among developmental scientists: Baltes and colleagues' SOC model (e.g., Baltes, 1997; Freund, 2008).

The SOC model has proven useful for understanding ISR across much of the life span (early adolescence through very late adulthood; Baltes, Lindenberger, & Staudinger, 2006), and emphasizes three core self-regulatory action processes of Selection, Optimization, and Compensation (e.g., Baltes, 1997; Freund & Baltes, 2000, 2002). Selection involves channeling one's resources towards a particular goal or a small number of goals; Optimization refers to actions that maximize one's chances for success in attaining the goal; and Compensation refers to adjustments in goal pursuit given losses in resources (Freund & Baltes, 2002).

Lerner and his colleagues (Bowers et al., 2011a; Gestsdóttir & Lerner, 2007; Zimmerman et al., 2007, 2008) have illustrated that adolescents' SOC skills are associated with higher levels of the Five Cs of PYD (competence, confidence, connection, character, and caring) as well as contributions to the self and others. For example, Gestsdóttir and Lerner (2007) reported that SOC scores correlated positively with PYD and youth contribution and negatively with problem behaviors such as substance use and delinquency. Subsequent studies found that SOC scores exhibited concurrent and predictive relations, in expected directions, with measures of both healthy and problematic development in early and middle adolescence (e.g., Gestsdóttir et al., 2009, 2010; Zimmerman, et al., 2007, 2008).

The components of the SOC model share some similarities with other contemporary concepts of self governance behaviors. For instance, individuals possessing higher levels of *grit* (Duckworth, et al., 2007), or perseverance and passion for long term goals, are likely skilled in compensation, adjusting for losses in resources while doggedly striving towards their goals. In addition, the SOC model is related to the 21st Century Skills initiative (Trilling & Fadel, 2009), which holds that in order to succeed in today's environment, children must not only learn key core subjects in school, but also develop self-regulatory "Life and Career skills" in order to translate this knowledge into goal achievement. This position is shared by Heckman and colleagues, who have argued that self-regulatory (or self-control) skills are vital to the economic success of individuals (e.g. Cunha & Heckman, 2007). While existing research has *described* the development of ISR in adolescence, and is beginning to *explain* the links between ISR and positive development during this period, to date little applied research has examined means to *enhance* youth ISR development.

The GPS to Success Growth Grids: Indices of Intentional Self-Regulatory Skills

The development of key life skills is a central element of many youth development programs (Duerden, et al., 2012). For instance, in their in-depth, qualitative investigation of the practices of 11 high-quality rural and urban youth development programs, Larson and Angus (2011) discovered that, despite diversity in their mission, population served, and typical activities, each program sought to foster “strategic thinking,” which they defined as “dynamic systems reasoning to anticipate real-world scenarios and plan work” (p. 277). This focus on life skills is not limited to these 11 programs. The 4-H Program, America’s largest youth development program, has also long focused on developing life skills among participating youth (Boleman, Cummings, & Briers, 2004; Boyd, Herring, & Briers, 1992). Putting life skills like strategic thinking to work towards achieving goals requires coupling them with intentional self-regulatory actions (Rotherham & Willingham, 2009).

Mentoring programs, which are as diverse as they are widespread (DuBois & Karcher, 2014), may be ideal contexts for developing skills such as ISR (Lerner, Napolitano, Boyd, Mueller, & Callina, 2014). However, currently there are no measures of ISR designed explicitly for the mentoring context (Bandy & Moore, 2010). Despite this limitation, some evidence suggests that participation in mentoring-based youth development programs may lead to increases in youth ISR skills (Mueller, et al., 2011). However, these data were collected as part of the larger 4-H Study (e.g., Lerner, et al., 2011), and were comprised of a subset of items on a lengthy questionnaire collected at yearly intervals. In addition, these data did not include mentor evaluations of youth ISR skills, data that could serve to both “triangulate” ISR assessment as well as to provide valuable insight into the mentor/mentee relationship. As mentoring programs increasingly turn to research-based practice (Rhodes, 2008) to attract funding in a highly competitive context, the need for a useful, efficient, and valid assessment of ISR is clear.

We designed the *GPS to Success* growth grids to meet this demand. The growth grids were based on the theoretical foundations of the SOC model of ISR (e.g., Freund & Baltes, 2002), and on the findings of a series of empirical studies (e.g., Geldhof, Bowers, Gestsdóttir, Napolitano & Lerner, in press; Gestsdóttir & Lerner, 2007, Zimmerman, Phelps, & Lerner, 2007, 2008) that used the SOC framework. In translating the SOC model for use in mentoring programs, the *GPS to Success* materials use the metaphor of a car's GPS navigation system – you "choose your destination" and your GPS (your SOC skills) provides "strategies" that lead you to your destination (achieving a goal). In the GPS framework, "G" stands for "Goal Selection," and reflects Selection skills; "P" stands for "Pursuit of Strategies," and reflects Optimization skills; and "S" stands for "Shifting Gears," and reflects Compensation skills.

The growth grids were arrayed as rubrics, with descriptions of criteria needed for a particular score on a variety of ISR actions. We chose this structure with an aim to facilitate effective mentoring by allowing mentors or mentees to identify mentee strengths and weaknesses in particular ISR actions, and adjust practices or activities accordingly. The items' content was derived from particular skills represented in the SOC model, and incorporated concepts from the PYD literature (e.g., Benson, 2008; Damon, 2008; Dweck, 2006; Larson, 2000, 2006; Lerner, 2007). All items were scored in terms of two dimensions: the mentee's level of skill and level of initiative in using the particular ISR action. Scores ranged from 1 (which entailed a youth being "pre-aware or disengaged" in their use of a self-regulatory action) to 5 (which entailed the youth showing "consistent initiative and skill mastery"). For an example of a GPS growth grid, see Figure 1.

Insert Figure 1 here

Although an initial study provided evidence of convergent validity between mentee's self-reported ratings on the GPS growth grids and their scores on a short form of the SOC questionnaire (Bowers et al., 2013), these findings were limited; the sample size in the study was relatively small and included only youth involved in 4-H mentoring programs. In addition, although we were able to provide reliability of the GPS scales and assess the correlations between mentor-rated and youth self-reported GPS, we did not model GPS using latent approaches or test invariance across raters. Finally, the data were cross-sectional and did not allow us to test for longitudinal measurement invariance.

The Present Study

To address these limitations in the present research, we used a series of confirmatory factor analyses to parsimoniously model the factorial structure underlying responses to the GPS growth grids and to test if this factorial structure is invariant across three times of measurement. As older mentees (14 years and older) and their mentors and younger mentees (ages 10 -13) and their mentors, completed different forms, we tested for factorial invariance (configural, weak, and strong) across raters (mentor / mentee) and times of measurement; we conducted these analyses separately for each age group. Invariance testing is a critical and often overlooked step for longitudinal research, and provides researchers with confidence that the results of future analyses reflect patterns of change in the latent constructs of interest, rather than measurement artifacts. These analyses also provide an initial assessment of the patterns of latent correlations, means, and variances among the resulting factors. Given *GPS to Success'* foundation in the empirically well-supported SOC framework (e.g., Freund & Baltes, 2002), we anticipated that mentee and mentor responses to the GPS growth grids, within each age group, were based in a shared, longitudinally invariant factorial structure.

Method

Participants

Participants in the *GPS to Success* program were 415 mentor-youth pairs who came from 24 sites representing 15 youth-serving programs in the United States. There were 415 dyads (pairs) of mentors and youth, although some mentors had more than one mentee in the study. In all, 115 mentors participated in the study, along with 415 of their mentees. Attrition rates were low: of the 415 mentor-youth pairs, 86% of mentors (357) and 85.3% of mentees (354) participated in the three times of data collection involved in this research, and 6.5% of mentors (27) and 10% of youth (41) participated in two of three times of data collection. Finally, 7.5% of mentors (21) and 4.8% of youth (20) participated in one time of data collection.

Of the 415 youth who participated in the study, 52% were male, and 48% were female. At Time 1, the mean age of participants in the younger age group was 12.23 years (*SD* = .74, range = 10.14-13.50 years old) while the mean age for the older group was 15.91 years (*SD* = 1.67, range = 14.04-20.65 years old). Of the 415 participants, 0.3% of participants were in 5th Grade, 27% of participants were in 6th Grade, 22% of participants were in 7th Grade, 18% of participants were in 8th Grade, 8% of participants were in 9th Grade, 8% of participants were in 10th Grade, 9% of participants were in 11th Grade, and 8% of participants were in 12th Grade or higher.

The sample was diverse in regard to ethnicity and maternal education status. Self-reported ethnicity was 32% Hispanic/Latino, 28% Black/African American, 22% White/Caucasian, 7% Asian/Pacific Islander, 7% Multiethnic/Multiracial, 1% Native American, and 3% Other. Of the 278 participants who reported that they knew their mother's level of education, 10% had "8th Grade Education or Less," 10% had "Some High School," 18% had "High School Diploma/G.E.D.," 18% had "Some College," 33% had "A College Degree," and 11% had "A Master's Degree or Higher." Twenty-one percent (*n* = 75 participants) reported that they did not know their mother's level of education, and 15% (*n* = 62 participants) did not reply.

Of the 115 mentors who participated in the study, 58.8% were female, and 41.2% were male. The average age of mentors was 33.6 years (*SD* =8.9). The self-reported ethnicity of the mentors was 64% White/Caucasian, 19% Black/African American, 8% Hispanic/Latino, 6% Asian/Pacific Islander, 3% Multiethnic/Multiracial, and 1% Native American. Mentors were adult community members, and did not include youth participants' peers.

At the start of the study, the mentors in 333 of the possible 415 mentor/mentee dyads reported on the length of their relationships with each youth. Of these 333 responses, 3.6% (*n* = 12) reported having just met their mentee; 22.8% (*n* = 76) reported having known their mentee a few weeks; 30.9% (*n* = 103) reported having known their mentee for several months; 20.1% (*n* = 67) reported having known their mentee about a year; and 22.5% (*n* = 75) reported having known their mentee for several years. While this information provides a potential source of variance to explore in future work, this sample is somewhat limited in that only about 75% of mentoring relationships in this sample had the recommended length for mentor's assessments of youth attributes (i.e., three months; Nakkula & Harris, 2005). We address this limitation in the Discussion section.

We assessed older and younger mentees and their mentors who provided responses to the growth grids. Several cases did not provide these data and were removed from the analyses. Therefore, we assessed 209 dyads involving youth above Age 14, and 200 dyads involving youth younger than Age 14.

Procedure

When mentors agreed to participate, they were sent consent forms detailing the purpose of the study, how confidentiality would be maintained, study procedures, and information regarding compensation. In order to participate, a mentor-mentee participant dyad completed these consent forms for the mentor, the mentee, and, if the mentee was under the age of 18, obtained consent from the mentee's guardian. These forms were mailed back to the researchers, and a member of our research team assigned each dyad a unique identification number. This identification number was not linked to personal identifiers. A member of the research team then emailed this identification number to the mentor, who entered it throughout the study process.

Before collecting data, members of the research team trained mentors or mentor coordinators to introduce and implement *GPS to Success* into their mentoring practice. These trainings were conducted either online or in person. Members of the research team trained mentors or mentor coordinators in the GPS terminology, scoring the GPS growth grids, and how to introduce the terminology and measures to their mentees.

For the first, baseline assessment Time (T) 1, we provided mentors with activities that they could use to introduce GPS to their mentees. Following this introduction, we asked mentors (reporting on the mentee) and mentees (self-report) to complete the growth grids for the first time. Mentors and mentees could complete their growth grids concurrently, but mentors were instructed to not provide answers or guidance beyond addressing issues of reading comprehension. The growth grids could be completed in either online or by using paper forms based on the preference of the youth-serving organization. Mentor and mentee participants were asked to score the growth grids using the same procedure two additional times, T2 and T3.

Although data collection began in February, 2011 and ended in January, 2012, youth development programs varied in their start and completion dates. Seventy-nine percent (n = 328) of mentor-youth pairs completed data collection in fewer than three total months, and no program took longer than seven months to complete data collection. All mentor-youth dyads in a particular youth-serving organization completed measures within a two-week window at each time of data collection, which accounted for small variations in within-group time-lag.

Measures

This research involved tests of the factorial structure and invariance of the GPS growth grids, the core measurement component of the *GPS to Success* program. We begin by describing the overall structure of the mentor rated and mentee-self reported versions of measures. Following these descriptions, we describe the differences in these measures across age groups.

Growth grids – General

We developed the GPS growth grids with two measurement goals. First, we sought to assess mentees' self-reported use of self-regulatory actions, as well as their mentors' ratings of their use of these actions. Second, since the measures were to be used within a mentoring context, we designed the growth grids to be simply and quickly scored and to promote conversation between mentors and mentees. To accomplish these goals, we designed the growth grids to have a rubric-like structure. Participants rated use of self-regulatory actions in terms of the mentee's initiative in using the action appropriately as well as the mentee's skill in using this action.

On each growth grid, self-regulatory actions were listed at the uppermost row of the rubric, with possible responses arrayed vertically below in columns. The content of each "cell" described the mentee's use of a particular self-regulatory action. We worked with a group of youth development practitioners to adapt the more technical language of the mentor growth grids to be developmentally suitable for the mentee self-reported versions. Full details of this process are reported elsewhere (Bowers et al., 2013).

All growth grids shared the same scoring structure based on ratings of mentee initiative and skill in using a self-regulatory action. Mentees were asked to select which "cell" was most like them for each described skill. Mentors were asked to select which "cell" was most like their mentee. The possible responses ranged from 1 (described on the mentor rubric as "Lacks skill, pre-aware or disengaged") to 5 ("Consistent initiative, skill mastery"). We considered responses on the items to be ordinal in nature, as we perceived the difference between, for instance, a score of a 2 ("Lacks initiative, low skill") and a 3 ("Emerging initiative, basic skill") as qualitatively different than the difference between a score of 3 and of 4 ("On and off initiative, skill competence").

Growth grids for older mentees (14 years and older) and their mentors

Older mentees and their mentors completed three separate Goal Selection (G), Pursuit of Strategies (P), and Shifting Gears (S) growth grids at each time of measurement. The G and S growth grids included four items each, while the P growth grid included five items. Given that the GPS is based in Baltes' and colleagues SOC model (e.g., Freund & Baltes, 2002), the G growth grid assessed skills related to Selection, the P growth grid assessed skills associated with Optimization, and the S growth grid assessed skills associated with Compensation. Figure 2 presents a complete list of the self-regulatory skills assessed in the measures.

Insert Figure 2 here

Growth grids for younger mentees (10-14 years) and their mentors

At each time of measurement, younger mentees and their mentors completed a single GPS growth grid that included a subset of six items also included in older mentee/mentor measures. We chose these six items because they were analogous to the nine items that Gestsdóttir and Lerner (2007) used to model a unitary SOC construct for younger adolescents in their research. Figure 2 also provides a complete list of the younger mentee growth grids.

Analyses

The goals of this research were to identify the factorial structure for responses to the GPS Growth Grids and, as well, to ascertain whether this structure was invariant across mentor and mentee ratings and across three times of measurement. Such invariance would indicate that responses to the growth grid could consistently be explained by the same latent construct or constructs. These analyses allow for a report of the correlations of the latent factors across raters, the stability of latent factors across time, as well as the latent means and variances across time. To test for invariance, we took a four-step approach. Steps 1 and 2 involved data from older mentees and their mentors, while Steps 3 and 4 involved data from younger mentees and their mentors.

1. In order to develop a baseline understanding of the factorial structure of these data, we first tested the fit of a three-factor (G, P, and S) model for older mentees and their mentors at T1. If the three-factor solution did not explain these data, we planned to respecify the model until we achieved an appropriate and parsimonious solution.

2. Using the acceptable model derived from Step 1, we tested for configural, weak, and strong invariance across raters and across times of measurement.

3. We developed a baseline single factor (GPS) model for younger mentees and their mentors. If the hypothesized single factor structure did not fit these data, we planned to respecify the model until we achieved an appropriate and parsimonious solution.

4. Using the acceptable model derived from Step 3 as a foundation, we tested for configural, weak, and strong invariance across time and rater for younger mentees and their mentors.

All analyses were conducted using MPlus 7 (Muthén & Muthén, 1998-2013). Because these data were ordinal in nature, we used the procedure suggested by Millsap and Yun-Tien (2004) to test for measurement invariance. Model fit for each analysis was assessed by the root mean square error of approximation (RMSEA) 90% confidence interval, the Comparative Fit Index (CFI), and the Tucker-Lewis Index (TLI) values. Acceptable fit cutoffs were CFI and TLI values > .90 and RMSEA confidence interval upper limit < .08 (e.g., Marsh, Hau, & Wen, 2004). The criterion for acceptable change in fit for invariance testing was a decrease CFI <.01 per invariance step, as suggested by Cheung and Rensvold (2002). All analyses were calculated using robust weighted least squares estimation, which has been shown to be an effective approach for categorical data with sample sizes as low as 200 (Muthén, du Toit, & Spisic, 1997).

Results

The goals of our analyses were to identify and test the invariance of the factor structure of the GPS Growth Grids. Our analyses proceeded in four steps.

Step 1 – Baseline older mentee and mentor factor structure at T1

As described above, we hypothesized that the responses for mentors and mentees in the older age group could be modeled by separate G, P, and S constructs that were conceptually consistent with Baltes and colleagues' (e.g., Freund & Baltes, 2002) S, O, and C, respectively. Given this prediction, and the computationally intensive nature of these analyses, we first tested this model using data at T1 only. Each construct was identified by the raters' relevant responses to items on the G, P, and S rubrics, respectively.

This initial model fit well (χ^2 (df =284) = 369.98; RMSEA = .039; 90% CI [.026, .049]; CFI: .993; TLI: .993). However, each of the latent correlations among the three factors for both mentees and mentors was very strong (rs ranging from .90 – .99). As the typical discriminant validity cutoff values for latent correlations are .80 or .85 (Brown, 2006), this finding suggested that the G, P, and S factors failed to differentiate as expected for older mentees and their mentors in this sample at Time 1.

To identify the most parsimonious model for these data, we next tested a series of models in which we iteratively collapsed one pair of highly correlated factors at a time, within raters, until a significant difference in model fit was achieved, or until both mentor and mentee data were modeled by a single "GPS" factor. Significant change in model fit was calculated using Mplus *difftest* option, and defined as p >.001 for each chi-square difference test. We began by collapsing mentee factors, as Mplus reported issues with a non-positive definite psi matrix for these factors. Across four iterations with no significant change in fit, we reached a final model that included single "GPS" factors for both mentors and mentees. This final model was characterized by good fit (χ^2 (df =298) = 417.21; RMSEA = .044; 90% CI [.034, .054]; CFI: .991; TLI: .990). Given these characteristics, we progressed with a single-factor model to the invariance tests in the next step.

Step 2: Factorial invariance for single-factor GPS model across time and across older mentee and mentor ratings

We next tested a single factor GPS model that was configurally invariant across mentor and mentee ratings, as well as three times of measurement. This model and all subsequent models in Step 2 included the additional invariance constraints specified by Millsap and Yun-Tien (2004) for testing for factorial invariance in categorical data. This model fit well, (χ^2 (*df* =2923) = 3324.55; RMSEA = .026; 90% CI [.021, .030]; CFI: .989; TLI: .989), and indicated that older mentees' and their mentors' responses to the growth grids could be explained by a configurally invariant single GPS item across three times of measurement. Standardized item loadings for each factor are presented in Table 1.[2]

Insert Table 1 here

We next tested for weak, or loading invariance by equating the loadings of indicators to be equal across raters and across time. This model also fit well, (χ^2 (*df* =2984) = 3396.41; RMSEA = .026; 90% CI [.021, .030]; CFI: .989; TLI: .989), and displayed weak invariance across rater and time by passing the Δ (change in) CFI <.01 invariance testing threshold (Cheung & Rensvold, 2002). Thus, indicator loadings displayed an invariant pattern across mentee and mentor ratings as well as time.

Finally, we tested for strong invariance by equating thresholds to be equal across rater and time. Six of the 13 indicators did not have the full number of thresholds (e.g., no responses in the lowest category, a score of "1") at any one time of measurement. Therefore, aside from the threshold required of each indicator to specify the model, these items' thresholds were freely estimated instead of equated, rendering this a partial test of strong invariance (see Byrne, Shavelson, & Muthen, 1989). Nevertheless, the resulting model was characterized by good fit (χ^2 (*df* =3088) = 3656.80; RMSEA = .030; 90% CI [.026, .033]; CFI: .984; TLI: .985), and passed the Δ CFI <.01 invariance testing threshold. Thus, the older mentee and mentor data had an invariant factor structure, pattern of item loadings, and thresholds across raters and across time. However, the strong invariance finding should be tempered by the "missing" thresholds for some indicators. We explore the implications for these findings in the Discussion.

As indicated above, these analyses also provide additional information about the reliability of the GPS factors, the latent correlations across raters within time, the stability of latent factors across time, and the factor means and variances. Consistent with the recommendations of Napolitano and colleagues (Napolitano, Callina, & Mueller, 2013), we calculated reliability using a composite approach (e.g., MacDonald, 1999) and weighted least-squares based estimation. Across the three times of measurement, both mentor (ω = .98, .98, .98, respectively) and mentee (ω = .90, .90, .92, respectively) GPS factors displayed strong reliability. Mentor and mentee GPS factors were significantly correlated at each time of measurement. However these correlations were not strong (*r*s = .36, .31, and .35, respectively; *df* = 3,088). On the other hand, the GPS factors displayed high stability within raters across time. Table 2 presents a list of these latent correlations.

Insert Table 2 here

Relative to Time 1, mentee latent means were higher in Times 2 and 3, while the mentor latent mean was lower at Time 2, but higher at Time 3. In addition, mentor GPS factors were characterized by greater levels of variance than were mentee GPS factors. Table 3 presents a list of factor means and variances.

Insert Table 3 here

Step 3: Baseline younger mentee and mentor factor structure at T1

We then tested the younger mentee and mentor data. We hypothesized that the responses for mentors and mentees in the younger age group could be modeled by a single GPS construct, consistent with prior research that indicated that SOC in younger adolescence exists as a global, rather than tripartite, factor structure (Gestsdóttir & Lerner, 2007). We tested this prediction first using T1 data for younger mentees and their mentors. The single GPS construct was identified by the raters' relevant responses to the six items on the GPS growth grid. This initial model fit well (χ^2 (*df* =53) = 61.57; RMSEA = .028; 90% CI [.000, .055]; CFI: .999; TLI: .998), supporting our hypothesis that younger mentee and mentor data could be modeled by a single GPS construct.

Step 4: Factorial invariance for single-factor GPS model across time and across younger mentee and mentor ratings

We next tested whether the single-factor GPS model was configurally invariant across mentor and mentee ratings across three times of measurement. Again, this model and all subsequent models in Step 4 included the additional invariance constraints specified by Millsap and Yun-Tien (2004). The configurally invariant single GPS factor model fit well, (χ^2 (*df* =585) = 661.02; RMSEA = .025; 90% CI [.012, .035]; CFI: .996; TLI: .995), and indicated that younger mentees' and their mentors' responses to the growth grids could be explained by a configurally invariant single GPS item across three times of measurement. Standardized item loadings for these models are presented in Table 3.

We next tested for weak invariance by equating the loadings of indicators to be equal across raters and across time. This model also fit well, (χ^2 (df =610) = 681.81; RMSEA = .024; 90% CI [.010, .034]; CFI: .996; TLI: .996), and displayed weak invariance across rater and time by passing the invariance testing threshold. Thus, indicator loadings displayed an invariant pattern across mentee and mentor ratings as well as time.

Finally, we tested for strong invariance by equating thresholds to be equal across rater and time. In the younger mentee and mentor sample, all indicators had each threshold available. This situation allowed us to test for strong, rather than partial invariance. The resulting model had good fit (χ^2 (df =700) = 1147.60; RMSEA = .057; 90% CI [.051, .062]; CFI: .975; TLI: .977), but failed the Δ CFI <.01 invariance testing threshold (Δ CFI = .021). Therefore, the younger mentee and mentor data were not invariant in regard to their thresholds across raters and across time.

Because strong invariance is critical for future analyses involving these latent factors, we next tested to see if the younger mentee and mentor data had measurement invariance across time, but within each rater group. The configural and weak invariant models differed from prior models in that item factor loadings and thresholds were equated across time but not across rater. The configural model fit well, (χ^2 (df =579) = 610.66; RMSEA 90% CI [.000, .029]; CFI: .998; TLI: .998), and, not surprisingly, indicated configural invariance across time. The next model equated loadings across time, but not rater, and also fit well (χ^2 (df =599) = 627.31; RMSEA 90% CI [.000, .028]; CFI: .998; TLI: .998), and passed the criterion for weak invariance.

Finally, we tested for strong invariance by equating thresholds to be equal across time, but not rater. The resulting model had good fit (χ^2 (*df* =671) = 693.84; RMSEA 90% CI [.000, .026]; CFI: .999; TLI: .999), and passed the Δ CFI <.01 invariance testing threshold. Therefore, the younger mentee and mentor data, separately, were invariant in terms of their pattern of factors, loadings, and thresholds across time. We explore the implications for these findings for future work involving the *GPS to Success* data and the GPS growth grids in the Discussion.

Again, these analyses also provided additional information about the reliability of the GPS factors, the latent correlations across raters within time, the stability of latent factors across time, and the factor means and variances. These findings differed from the older mentee age group. Across the three times of measurement, mentor GPS had high levels of reliability (ω = .96, .97, .97, respectively). Mentee GPS reliability was lower, but still acceptable (ω = .77, .79, .71, respectively). Mentor and mentee GPS factors were significantly correlated at Times 1 and 2. However, these correlations were not strong (*r*s = .26 and .27, respectively; *df* = 671). Notably, mentor and mentee GPS at Time 3 were not significantly correlated. On the other hand, the GPS factors displayed high stability within raters across time. Table 2 also presents a list of these latent correlations.

The pattern of latent means also differed for the younger mentee age group. Relative to Time 1, the mentee latent mean was lower in Time 2, but higher in Time 3. However, mentor latent means decreased were higher in Time 2 and Time 3 than in Time 1. Again, mentor GPS factors were characterized by greater levels of variance than were mentee GPS factors. Table 3 also presents a list of the factor means and variances.

Discussion

Developing intentional self-regulatory skills in youth is becoming a central goal for many mentoring programs (Balcazar & Keys, 2014). It is no surprise that this focus exists: ISR skills have consistently been shown to be associated with goal achievement and positive development across the life span (e.g., Freund & Baltes, 2002; Gestsdóttir & Lerner, 2007). Along with the increased prevalence of ISR promotion in mentoring programs, practitioners in these programs also have an increasing desire to measure the positive impact of their work to meet strategic, evaluation, and funding obligations (Lerner, 2012). Decisions based on these measures require the use of high-quality assessments that are theoretically based, developmentally appropriate, empirically validated, and suitable for longitudinal research in applied settings.

With these needs in mind, this research tested the factorial structure and measurement invariance of the GPS growth grids –measures of ISR designed for adolescents and their mentors in youth-serving programs. Finding invariant factorial structures would support future longitudinal work using these data (Horn & McArdle, 1992; Meredith, 1993) that could inform ISR-based mentoring programming. The content of the GPS growth grids were based in the SOC model of ISR (Freund & Baltes, 2002). Based on prior research that modeled the factorial structure of SOC in adolescence (Gestsdóttir, Bowers, von Eye, Napolitano, & Lerner, 2010; Gestsdóttir & Lerner, 2007), we hypothesized that older mentee and mentor responses could be invariantly modeled across time and rater (mentor or mentee) as three “G, P, and S” factors similar to S, O, and C, while younger mentee and mentor responses could be invariantly modeled across time and rater as a single “GPS” factor.

Our results can be summarized by two general statements. First, the hypothesized G, P, and S constructs for older mentees and their mentors were not sufficiently differentiated. Instead, the factorial structure for mentee and mentor raters in both age groups was best modeled as a single "GPS" factor. Second, with certain important caveats, responses to the GPS growth grids can invariantly be modeled by a single latent factor across time for both mentor and mentee raters in both the older and younger age groups. The identification of a single latent "GPS" factor is consistent with earlier pilot work that found a global composite measure of GPS most consistently predicted youth ISR as measured by the SOC questionnaire and PYD (Bowers et al., 2013). These findings allow for future longitudinal research on these constructs. In addition, as we will note, preliminary assessment of latent correlations, means, variances, and reliabilities for these factors raises important questions for future research.

How do we interpret the unexpected lack of differentiation among the G, P, and S factors among older mentees and their mentors? Theoretically, the model (Baltes, 1997) underlying *GPS to Success* was developed as a way to understand adaptive development through middle-age and into older adulthood, a period where individuals commonly experience losses in resources and functioning (Freund, 2008), and are therefore typically oriented towards maintenance and loss-prevention (Ebner, Freund, & Baltes, 2006). Middle-aged and older adults may differentiate between the components of SOC because using each type of action is required to maintain functioning or minimize loss in the context of declining resources (Freund, 2008). However, it may be that younger persons' typical orientation is towards growth and gains (e.g., Heckhausen, Dixon, & Baltes, 1989; Ogilvie, Rose, & Heppen, 2001), and such an orientation may lead to a different, less differentiated perception of the components of SOC.

Recent research provides some support for this idea. Using eight waves of data from the 4-H Study (e.g., Lerner, et al., 2011) Geldhof and colleagues demonstrated that instead of distinct S, O, and C factors, SOC may be best modeled by a reverse-code method factor, a

"Selection" factor, and a generalized "ISR" factor (Geldhof, Bowers, Gestsdóttir, Napolitano, & Lerner, 2013). It may be that our finding of a single GPS factor is consistent with this generalized "ISR" factor, as our "G" growth grid included concepts that were not included in the Selection questionnaire (e.g., "Choosing goals that help others / the community").

A second basis for the lack of differentiation among the G, P, and S factors may involve the mentors' ratings of older youth. Even with sufficient training, it may be difficult for mentors to assess and differentiate the G, P, and S of their mentees. Mentors may have limited exposure to their mentees' use of ISR actions outside the auspices of the mentoring program, or they may have known their mentee for a short period of time. Thus, when scoring on the growth grids, a mentor may reflect on a mentee's overall levels of ISR, rather than differentiating between, for instance, the way a mentee selects goals versus how the mentee pursues these goals. This interpretation should be tested in future research which, for example, could ascertain potential differences in factorial structures between mentors who have known their mentee for longer or shorter periods of time.

In regard to the second generalization about the present findings, it may be that responses to the GPS growth grids can invariantly be modeled by a single "GPS" latent factor across time for both mentor and mentee raters in both the older and younger age groups. However, there are important caveats for both older and younger age groups. Beginning with the older mentee and mentor data, our finding of strong invariance was limited to partial invariance (Byrne, et al., 1989) as six of the indicators demonstrated a "floor effect" and lacked the full range of response options (and therefore thresholds). There are few guidelines for interpreting partial invariance, and those that do exist are inconsistent with our data, as they involve comparing partially invariant models – where constraints on equating troublesome parameters are relaxed – to a poorly-fitting invariant model that specifies these constraints (e.g., Millsap & Kwok, 2004; Widaman, Ferrer, & Conger, 2010). While we were able to equate at least a majority of the indicators' thresholds, as has been recommended (Vandenberg & Lance, 2000), it is possible that older mentee and mentor models could have lacked strong invariance had six of the indicators not displayed the floor effect. Future versions of the GPS growth grids should recalibrate the language of the lowest level (or "Pre-aware, disengaged") response options to correct this issue and allow for full tests of measurement invariance among older mentees and their mentors.

In respect to the younger age group, we found strong invariance for mentee and mentor GPS across time; however, unlike the older age group, we did not find such invariance *across* raters. This finding suggests that future longitudinal work should explore changes in GPS separately for younger mentees and their mentors. Why might mentors and mentees vary in terms of their indicator thresholds? One reason may be differences in training. The mentors were trained to score the growth grids by members of the research team, or in some cases, by their mentor coordinators. Mentee training was less consistent and delegated to the mentors. In addition, it could be that young adolescents with low GPS may instead highly rate their abilities, similar to the positive illusory bias of children and young adolescents with ADHD or similar disorders (e.g., Owens, Goldfine, Evangelista, Hoza, & Kaiser, 2010).

Taken together, these issues may have resulted in disagreement in the GPS ratings of younger mentees and their mentors. In future versions of *GPS to Success,* more consistent, developmentally appropriate training for younger mentees could serve to mitigate this issue and increase variability in mentee ratings.

Finally, our assessment of latent correlations, means, variances, and reliabilities raises important questions for future research. The latent interrater correlations were unexpectedly low, and in the case younger mentee/mentor T3, they were non-significant. Of course, absolute agreement between raters on the mentee's skill level is not likely. Nevertheless, these low correlations raise questions regarding the sources of this disagreement. Might mentors be overly harsh in their assessments, or could adolescents be overly generous in their self-ratings? Future work should explore longitudinal patterns of increasing or decreasing concordance among mentor and mentee ratings. In addition, with this low shared variance, future work should assess whether mentor or mentee GPS rating is a more accurate predictor of goal attainment.

Given that these data were nested within a larger intervention that sought to improve the ISR skills of adolescents, we had hoped to find "across-the-board" increases in the latent means for GPS over time. However, the patterns of the latent means were more complex, in some cases showing patterns of temporary decline at T2 with a rebound at T3. What might account for these trajectories? We suspect that higher levels of mentor's use of *GPS to Success* activities – which involved games, thinking exercises, and videos designed to stimulate conversation and increase awareness of GPS skills – are likely associated with increases in mentor-reported and mentee self-reported GPS. Future research should test the hypothesis. In addition, it is important to note that these data did not include a control group, and thus these varying trajectories could represent standard variations of assessed ISR for adolescents within a several month period.

Finally, the lower levels of reliability and non-significant interrater correlations at T3 suggest some implications for the younger mentee data. As we have suggested, it may be that younger mentees required more extensive training in the GPS growth grids than we had provided. While there is no way to directly test this assertion with the present data, future work could investigate whether the GPS of mentees with higher levels of *GPS to Success* activity participation demonstrated greater levels of reliability than their less frequently participating peers. The hypothesis here would be that *GPS to Success* activity participation would lead to a greater understanding of the GPS concept, and thus a more reliable scoring of the items.

Limitations

These findings are limited in several ways. First, the relatively small samples for both age groups were not ideal for categorical data analyses. Future work should involve larger samples and replicate the factorial structure and invariance that we described here. In addition, at Time 1, about a quarter of mentors reported knowing their mentee for a few weeks or shorter. Future work should examine whether the factor structure in these dyads differs from that of longer-established dyads. Another limitation was the variability in measurement occasion time-lag both within and across different youth serving programs. Future work should investigate whether variations in time-lag affected factorial structure and measurement reliability, as well as cross-sectional and longitudinal relations among mentor and mentee GPS.

The applied nature of this research project may limit the generalizability our findings. Mentoring groups have different levels of resources and different practices. Therefore, we did not adopt a "one-size-fits-all" policy for data collection techniques and time frames. This procedure may have introduced some variance in these data. In addition, some mentors in our sample completed data for several of their mentees. Future work should explore potential hierarchical or nested effects on these data. Finally, in terms of the specific results of this research, we did not test whether differences in mentoring program structure or content influenced GPS factorial structure. It may be that youth in athletic based programs, for instance, have a well-defined "S" factor, given their own experiences with loss in competition. Future work should investigate if GPS factorial structure differs across mentoring group type.

Conclusions

Although the present study has important limitations, our findings provide preliminary support for the use of the GPS growth grids to assess longitudinal change in the ISR of youth in mentoring programs. The invariant factorial structures presented here provide researchers with a foundation to use existing *GPS to Success* data to assess which youth, mentor, or youth-serving program characteristics are supportive of ISR promotion, and perhaps ultimately supportive of thriving across adolescence. The future work supported by the present research may also suggest refinements to the GPS growth grids that ensure these measurement tools are useful, efficient, and valid assessments of ISR for youth in mentoring programs.

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Footnotes

[2] A full listing of item thresholds for both younger and older age groups is available from the corresponding author by request.

Table 1

Standardized item loadings on GPS factor for mentor and mentee versions of growth grids across three times of measurement

Item	Older T1	Older T2	Older T3	Younger T1	Younger T2	Younger T3
Mentor G1	.837	.875	.882	.885	.902	.915
Mentor G2	.846	.792	.840	-----	-----	-----
Mentor G3	.916	.917	.931	-----	-----	-----
Mentor G4	.920	.936	.952	-----	-----	-----
Mentor P1	.872	.916	.949	-----	-----	-----
Mentor P2	.894	.854	.921	.886	.940	.941
Mentor P3	.925	.930	.947	-----	-----	-----
Mentor P4	.880	.914	.943	.910	.893	.910
Mentor P5	.891	.879	.910	.939	.925	.902
Mentor S1	.862	.868	.886	.939	.896	.920
Mentor S2	.858	.828	.870	.825	.889	.917
Mentor S3	.863	.875	.944	-----	-----	-----
Mentor S4	.801	.801	.853	-----	-----	-----
Mentee G1	.756	.690	.662	.500	.608	.460
Mentee G2	.610	.530	.579	-----	-----	-----
Mentee G3	.629	.734	.751	-----	-----	-----
Mentee G4	.687	.740	.673	-----	-----	-----
Mentee P1	.692	.640	.718	-----	-----	-----
Mentee P2	.754	.683	.781	.598	.629	.448
Mentee P3	.664	.669	.792	-----	-----	-----
Mentee P4	.554	.543	.726	.680	.720	.599
Mentee P5	.679	.703	.658	.652	.673	.629
Mentee S1	.692	.707	.781	.587	.579	.501
Mentee S2	.639	.484	.704	.537	.505	.567
Mentee S3	.463	.645	.557	-----	-----	-----
Mentee S4	.497	.489	.631	-----	-----	-----

All loadings significant p <.001.

Table 2
Standardized latent correlations of GPS factors within and across time. Younger mentees' and mentors' correlations displayed below the diagonal, older mentees' and mentors' correlations displayed above the diagonal

Factor	1	2	3	4	5	6
1. T1 Mentee GPS	1	.750***	.653***	.359***	.228**	.238**
2. T2 Mentee GPS	.675***	1	.881***	.306***	.305***	.367***
3. T3 Mentee GPS	.629***	.705***	1	.285***	.276***	.354***
4. T1 Mentor GPS	.281**	.215**	.179	1	.871***	.817***
5. T2 Mentor GPS	.379***	.272**	.165	.749***	1	.900***
6. T3 Mentor GPS	.251**	.155*	.144	.622***	.853***	1

*p <.001 = ***, p <.01 = **, p <.05 = **

Table 3

Latent means and variances for older and younger mentee and mentor GPS factors across three times of measurement

Factor	Latent mean	Latent variance
T1 Older Mentee GPS	----	0.671
T2 Older Mentee GPS	0.346	0.678
T3 Older Mentee GPS	0.504	0.908
T1 Older Mentor GPS	----	3.101
T2 Older Mentor GPS	-0.282	1.460
T3 Older Mentor GPS	0.024	1.739
T1 Younger Mentee GPS	----	0.429
T2 Younger Mentee GPS	-0.036	0.437
T3 Younger Mentee GPS	0.112	0.286
T1 Younger Mentor GPS	----	4.139
T2 Younger Mentor GPS	0.070	4.376
T3 Younger Mentor GPS	0.313	4.689

Figure 1: Example GPS Growth Grid: Younger mentee's self-reported GPS

Self-Reflection: Young Adolescent GPS

YOUTH LEVEL FOR AGES 10-13

Scoring Levels	Choosing Your Destination	Sticking to a Plan	Showing Persistent Effort	Checking Your Progress	Seeking Different Help	Substituting Strategies
5 I work on this all the time and I'm excellent at it.	I consistently choose a small number of important goals for myself. These goals might be tough, but I feel I can meet them.	When I choose goals, I consistently make step-by-step plans to meet them. After I make these plans, I stick to them, and use my plans to help make choices every day.	I consistently put in my full effort to meet my goals.	I consistently check to see if the steps on my plans are helping me meet my goals. If they aren't, I might think about changing my plan.	I consistently ask for help to meet my goals. I ask the people I know or I'll search for someone new who can help.	When I'm having trouble meeting my goals, I consistently figure out new ways to change my plans so I can still meet my goals.
4 About half the time, I show initiative and skill at this.	About half of the time, I choose a small number of important and challenging goals for myself. I usually think I can meet these goals. Sometimes, I work on too many goals at once.	About half the time I choose a goal, I make a step-by-step plan to meet it. Sometimes, it's hard for me to stick to the plan, so I don't.	About half the time, I really work hard to meet my goals. Sometimes I'll take a break or get distracted.	About half the time, I'll check to see if my plans are working to meet my goals. Other times, I'll forget, or I'll just keep working.	About half the time, I ask for help to meet my goals from the people I know. Sometimes, I even ask new people for help.	About half the time, I have trouble meeting my goals, I sometimes figure out new ways to change my plans. Other times, I just try the same plans again.
3 I really want to get better at this, and I need my mentor's help.	I want to get better at choosing a few important goals. I need my mentor to help me choose these goals	I want to use step-by-step plans to meet goals, but I need my mentor to help me make this plan and keep me focused on each step.	I want to put a lot of effort into meeting my goals, but I need my mentor to keep me working hard because I often get distracted.	I want to get better at checking to see if my plans are working. I need my mentor to show me, or tell me, when my plans is or is not working.	I want to work on being able to ask for help to meet my goals. I need my mentor to remind me that it's OK to ask for help, and to tell me who I can ask for help to meet my goal.	I want to get better at changing my plans when I'm having trouble meeting my goals, but I need my mentor to show me how to change my plans, or what isn't working.
2 I don't think this is important, but I'll try if my mentor makes me.	I don't think it's important to set a few important goals for myself. If my mentor pushes me to think about goals, I'll work on them.	I don't really think plans are all that useful to meet my goals. I can meet my goals without plans. I'll make a plan only if my mentor pushes me to do it.	I don't think I need to work too hard to meet my goals. I'll put some effort into meeting my goals only if my mentor pushes me.	I think that checking to see if my plans are working is kind of a waste of time, but I'll check my plans if my mentor pushes me.	I mostly don't ask for help to meet my goals. I can do things on my own, even if I'm having trouble. I'll ask for help if my mentor pushes me to do it.	Most of the time, when I'm having trouble meeting my goals, it's not my fault. I'll change my plans, but only if my mentor pushes me.
1 I don't do this.	I don't have any goals in my life right now.	I don't make or use plans when I'm trying to meet goals.	I do not put any effort into meeting goals.	I don't ever really check to see if my plans are working or not.	I don't ever really ask for help, even when I'm having trouble.	I don't change my plans when I'm having trouble meeting my goals. My way will work eventually.

STEP-IT-UP-2-THRIVE

Figure 2: GPS actions and mentor language descriptions of maximum scores on growth grids assessing older mentees.

GPS Actions	Mentor language for describing a "5" or "Consistent initiative; skill mastery"
Choosing Your Destination (G)*	Consistently shows mastery and initiative by choosing meaningful, realistic, and demanding goals. Focuses on one or small number of goals at a time.
Choosing Goals That Help Others / Community (G)	Consistently shows mastery and initiative at choosing goals that benefit self and community.
Breaking Down Long Term Goals (G)	Consistently shows mastery & initiative at breaking down long term goals into short-term steps. Consistently identifies potential obstacles and solutions.
Identifying Relations Among Goals (G)	Consistently shows mastery & initiative at choosing goals that help in multiple ways and make meeting other goals easier.
Sticking to a Plan (P)*	Consistently shows mastery and initiative at making a plan to meet goals. Consistently uses this plan to guide actions that help meet goals.
Seizing the Moment (P)	Consistently shows mastery and initiative to act when the time or situation is right to help meet a goal.
Developing Strategies (P)	Consistently shows mastery and initiative at finding and using new strategies and at practicing current useful strategies to meet goals.
Showing Persistent Effort (P)*	Consistently shows persistent effort to meet goals. Consistently works to meet goals even if it is difficult.
Checking Your Progress (P)*	Consistently shows mastery and initiative at regularly checking goal progress and how strategies are working. These checks may lead to changes in strategies.
Substituting Strategies (S)*	Consistently shows mastery and initiative to substitute strategies and/or change parts of strategies to meet goals during difficulties.
Seeking Different Help (S)*	Consistently shows mastery and initiative to look for help from familiar and new people and resources. Uses familiar resources in new ways to help meet goals during difficulties.
Emulating Strategies of Others (S)	Consistently shows mastery and initiative to use the strategies of successful others to help meet goals during difficulties
Changing Goals without Feeling Bad (S)	Consistently shows mastery and initiative at accepting loss as part of success and begins to move to new goals. Keeps long term goals in perspective, and works to find a goal that is a better "fit"

* = Included in the younger mentee and mentor growth grid